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## (57) Abstract

Dairy products and dairy analogue products are sweetened with N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester. Dairy products include milk (from various species and of various milkfat content), enzyme treated milk, filled milk, cream, creamers, cultured milk, milk concentrates, dry milk, fluid and dried whey, fluid and dry milk based desserts and beverages, and fluid and dry aerated desserts and toppings. The dairy products also include frozen cultured milk products, such as frozen yogurt, and frozen fluid dairy products, such as ice cream, ice milk, sherbet, custards and french ice cream, mellorine, novelties, and the like. Dairy analogue products include soy milk, soy powder, caseinates, and non-dairy coffee whiteners, as well as frozen products such as sorbet and non-dairy novelties.

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- 1 -

## TITLE

USE OF N-[N-(3,3-DIMETHYLBUTYL)-L- $\alpha$ -ASPARTYL]-L-PHENYLALANINE 1-METHYL ESTER IN DAIRY AND DAIRY ANALOGUE PRODUCTS

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## BACKGROUND OF THE INVENTION

## Field of the Invention

The invention relates to the use of the sweetener, N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester (neotame), in dairy and dairy analogue products.

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## Description of the Prior Art

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The N-alkylated aspartame derivative, N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester, is known as an extremely potent sweetening agent, as disclosed in U.S. Patent No. 5,480,668, the complete disclosure of which is incorporated by reference herein. Its sweetening potency, on a weight basis, is reported to be at least 40 times that of aspartame and about 8,000 times that of sucrose.

SUBSTITUTE SHEET (RULE 26)

N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is a highly potent sweetener. It would be advantageous to be able to utilize its sweetener potency in dairy and dairy analogue products. Such use is not described or suggested by the prior art.

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## SUMMARY OF THE INVENTION

This invention relates to a dairy product comprising N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester in an amount effective to sweeten the dairy product. The dairy products of this invention include, without limitation, milk (from various species and of various milkfat content), enzyme treated milk, filled milk, cream, creamers, cultured milk, milk concentrates, dry milk, fluid and dried whey, fluid and dry milk based desserts and beverages, and fluid and dry aerated desserts and toppings. The dairy products of this invention also include frozen cultured milk products, such as frozen yogurt, and frozen fluid dairy products, such as ice cream, ice milk, sherbet, custards and french ice cream, mellorine, novelties, and the like. Most preferably, the dairy products of this invention are no-sugar added dairy products. The invention also relates to a method of preparing a dairy product by incorporating an effective amount of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester in the dairy product to sweeten the product.

Another embodiment of this invention is related to a dairy analogue product comprising N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester in an amount effective to sweeten the dairy analogue product. The dairy analogue products of this invention include, without limitation, soy milk, soy powder, caseinates, and non-dairy coffee whiteners, as well as frozen products such as sorbet and non-dairy novelties. Most preferably, the dairy analogue products of this invention are no-sugar added dairy analogue products. The invention also relates to a method of preparing a dairy analogue product by incorporating an effective amount of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-

phenylalanine 1-methyl ester in the dairy analogue product to sweeten the product.

5 An additional embodiment of this invention is related to the use of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with other natural or high intensity sweeteners in dairy and dairy analogue products. These N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester sweetener blends are added to dairy and dairy analogue products in an amount effective to sweeten the product. In addition, this invention is directed to a method of sweetening dairy and dairy analogue products by the incorporation of  
10 N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with another sweetener in the dairy and dairy analogue products in an amount effective to sweeten these products.

#### DETAILED DESCRIPTION OF THE INVENTION

15 This invention is related to dairy and dairy analogue products having N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester as a component. Any form of neotame may be used in the dairy and dairy analogue products of this invention. For example, salts and metal complexes of neotame may be used, such as disclosed in U.S. Patent Application No. 09/146,963, U.S. Patent Application No. 09/146,964, U.S. Patent Application No. 09/148,134, and U.S.  
20 Patent Application No. 09/146,965, all filed September 4, 1998, and all of which are incorporated by reference herein. Other exemplary forms of neotame that may be useful in this invention include cyclodextrin/neotame complexes such as disclosed in U.S. Provisional Patent Application No. 60/100,867 and cocrystallized neotame disclosed in U.S. Patent Application No. 09/154,568,  
25 both filed September 17, 1998, and the disclosure of both of which are incorporated by reference herein.

It is believed that N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester will provide greater sweetener stability as compared to aspartame in

the dairy and dairy analogue products of the present invention. It is also believed that use of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester produces a higher quality dairy and dairy analogue product than other high intensity sweeteners.

5 The dairy products of this invention include, without limitation, milk (from various species and of various milkfat content), enzyme treated milk, filled milk, cream, creamers, cultured milk, milk concentrates, dry milk, fluid and dried whey, fluid and dry milk based desserts and beverages, and fluid and dry aerated  
10 desserts and toppings. The dairy products of this invention may be liquids, gels, emulsions, powders, and mixtures thereof. The dairy products also may be frozen fluid dairy products or frozen cultured milk products. The dairy analogue products of this invention include, without limitation, soy milk, soy powder, caseinates and non-dairy coffee whiteners, as well as frozen products such as sorbet and non-dairy novelties.

15 The dairy and dairy analogue products of this invention may be prepared using ingredients and techniques well known to those skilled in the art. The present invention includes incorporating N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester by heat processing, for example, high heat short time (HHST), ultra high temperature (UHT), batch, and vat processing. In the  
20 products of the present invention, it is important to mix the ingredients properly for good content uniformity.

The N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is added to dairy products in an amount effective to sweeten the product, typically at levels ranging from about 3 ppm to about 250 ppm, for no-sugar-added  
25 products. Preferably, the N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is added to no-sugar-added dairy products at levels in the range between about 5 ppm to about 150 ppm, and most preferably from about 10 ppm to about 100 ppm. Of course, lower levels may be used when an additional sweetener is present.

This invention is also related to non-reconstituted powdered dairy products, i.e., the powdered product prior to reconstitution, sweetened with N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester. The N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in these powdered dairy products in an amount effective to sweeten the product, typically at levels ranging from about 30 ppm to about 1,250 ppm for no-sugar added-products. Preferably, the N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is added to these no-sugar added, non-reconstituted powdered dairy products in the range between about 60 ppm to about 1,000 ppm, and most preferably from about 90 ppm to about 835 ppm. Of course, lower levels may be used when an additional sweetener is present.

Still yet another embodiment of this invention is related to dairy analogue products sweetened with N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester. The N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in the dairy analogue product in an amount effective to sweeten the product, typically at levels ranging from about 5 ppm to about 150 ppm for no-sugar added-products. Preferably, the N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is added to these no-sugar added dairy analogue products in the range between about 10 ppm to about 100 ppm, and most preferably from about 12 ppm to about 50 ppm. Of course, lower levels may be used when an additional sweetener is present.

An additional embodiment of this invention is related to the use of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with other natural or high intensity sweeteners in dairy and dairy analogue products. Other sweeteners that may be employed include, without limitation, aspartame, acesulfame-K, sucralose, saccharin, alitame, cyclamates, stevia derivatives, thaumatin, sucrose (liquid and granulated), high fructose corn syrup, high conversion corn syrup, crystalline fructose, glucose (dextrose), polyol sugar alcohols, invert sugar and mixtures thereof. Bulking agents may be used, as

well, to replace the bulking functions of sugar; some of these bulking agents can provide added sweetness in and of themselves. For example, compared to sucrose, Raftilose P95™ oligofructose is approximately 30% as sweet, isomalt is approximately 60% as sweet, and sorbitol is approximately 60% as sweet.

5 These N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester sweetener blends are added to dairy and dairy analogue products in an amount effective to sweeten the product. It should be understood that the amount effective or effective amount of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester necessary to sweeten the dairy and dairy analogue  
10 products of this invention is that amount necessary to provide a desired sweetness sensation in the mouth either alone or blended with other natural or high intensity sweeteners. Generally, the blended N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of about 0.1 ppm to about 100 ppm.

15 Generally, the amount of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester employed will be dependent on the particular application. For example, N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten no sugar added orange sherbet in an amount between about 5 ppm to about 250 ppm, more preferably  
20 from about 20 ppm to about 150 ppm, and most preferably from about 30 ppm to about 75 ppm.

Similarly, N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten no sugar added strawberry frozen yogurt generally in an amount between about 5 ppm to about 150 ppm, more preferably from  
25 about 20 ppm to about 100 ppm, and most preferably from about 30 ppm to about 75 ppm.

The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester in an amount effective to sweeten no sugar added



chocolate milk drink is from about 5 ppm to about 100 ppm, more preferably from about 20 ppm to about 75 ppm, and most preferably from about 25 ppm to about 40 ppm.

5 In the case of ice creams, N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten no-sugar-added, low fat vanilla ice cream generally in an amount between about 5 ppm to about 75 ppm, more preferably from about 10 ppm to about 45 ppm, and most preferably from about 12 ppm to about 30 ppm. N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten no-sugar-added, low fat  
10 chocolate ice cream generally in an amount between about 5 ppm to about 75 ppm, more preferably between about 10 ppm to about 45 ppm, and most preferably between about 12 ppm to about 30 ppm.

Similarly, N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten strawberry yogurt generally in an amount between  
15 about 3 ppm to about 70 ppm, more preferably between about 5 ppm to about 60 ppm, and most preferably between about 25 ppm to about 50 ppm. N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten no sugar added chocolate pie filling generally in an amount between about 9 ppm to about 200 ppm, more preferably between about 20 ppm to 150  
20 ppm, and most preferably 40 ppm to about 100 ppm.

In the case of powdered dairy products, N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten reconstituted hot cocoa mix generally in an amount between about 7 ppm to about 13 ppm, preferably between about 8 ppm to about 12 ppm, and most preferably between about 9  
25 ppm to about 11 ppm. N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten reconstituted whipped topping mix generally in an amount between about 5 ppm to about 75 ppm, more preferably between about 10 ppm to about 50 ppm, and most preferably between about 15 ppm and about 40 ppm. Also, N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-

phenylalanine 1-methyl ester can be used to sweeten reconstituted vanilla flavored instant pudding mix generally in an amount between about 10 ppm and about 75 ppm, more preferably between about 15 ppm and about 60 ppm, and most preferably between 20 ppm and about 50 ppm.

5 In the case of powdered dairy products that have not been reconstituted, N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten hot cocoa mix (non-reconstituted) generally in an amount between about 90 ppm to about 170 ppm, preferably between about 100 ppm to about 150 ppm, and most preferably between about 115 ppm to about 140 ppm. N-[N-  
10 (3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten whipped topping mix (non-reconstituted) generally in an amount between about 30 ppm to about 460 ppm, more preferably between about 60 ppm to about 300 ppm, and most preferably between about 90 ppm and about 245 ppm. Also, N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-  
15 methyl ester can be used to sweeten vanilla flavored instant pudding mix (non-reconstituted) generally in an amount between about 170 ppm and about 1,250 ppm, more preferably between about 250 ppm and about 1,000 ppm, and most preferably between 335 ppm and about 835 ppm.

In the case of dairy analogue products, N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-  
20 L-phenylalanine 1-methyl ester can be used to sweeten no sugar added strawberry sorbet generally in an amount between 5 ppm to about 150 ppm, more preferably between about 20 ppm to about 100 ppm, and most preferably between about 25 ppm to about 50 ppm. For the case of no-sugar-added low fat vanilla frozen dessert based on soy milk and soy protein, N-[N-(3,3-  
25 dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten this product generally in an amount between about 5 ppm and 75 ppm, more preferably between about 10 ppm and 45 ppm, and most preferably between about 12 ppm and 30 ppm.

The Examples which follow are intended as an illustration of certain preferred embodiments of the invention and no limitation of the invention is implied.

### DAIRY PRODUCTS

5 Various dairy product formulations were made with different levels of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester. These levels were selected to establish the levels that would be less sweet than acceptable and sweeter than acceptable. In addition, dairy product formulations were made with N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with another sweetener, i.e. sugar, aspartame, acesulfame-K, saccharin, or  
10 cyclamate.

Bench screening was used to evaluate each of the different prototypes for each basic formulation using 100% N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester. Also, bench screening was used to evaluate the formulations using N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-  
15 methyl ester blended with another sweetener. The tested examples included fluid, frozen fluid, cultured, and reconstituted powdered dairy products. These products covered a range of variables including: pH, processing, solids, fat levels, stabilizers, and flavors. The results from this bench screening established 3 ranges, going from a very general to a most preferred range for each  
20 application.

Example 1: No Sugar Added Orange Sherbet (24.4% total solids (TS), 1.4% butter fat (BF), 4.3% non-fat milk solids (NMS)).

The constituents used to formulate the No Sugar Added Orange Sherbet of Example 1 are shown below in Table 1.

TABLE 1  
Example 1 Formulation  
No Sugar Added Orange Sherbet,  
20 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester

5	Ingredient	Formula (%w/w)
	Skim milk	42.428
	Heavy whipping cream	3.2
	Water, distilled	32.65
10	LITESSE™ polydextrose (available from Cultor, New York, N.Y.)	3.9
	M180 MALTRIN™ maltodextrin (available from Grain Processing, Muscatine, IA)	8.4
	NEOSORB 60S™ sorbitol (available from Roquette, Keokuk, IA)	5.3
15	DARILOID 400™ (A mixture of guar, xanthan, carrageenan and locust bean gum available from The NutraSweet Kelco Company, Chicago, IL)	0.25
20	DM FREEZE 75K™ (a mixture of mono/diglycerides and polysorbate 80 available from American Ingredients, Kansas City, MO).	0.1
	N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L- phenylalanine 1-methyl ester	0.0020
25	Vanilla PLANIFOLINE™ 10X (Available from Florasynth, Teterboro, N.J.)	0.05
	Orange juice concentrate	3.72
	Total	100

30 The No Sugar Added Orange Sherbet of Example 1 was made by first blending all the dry ingredients. The dry ingredients were then added to water, cream, and skim milk. The mixture was mixed using medium shear forces. The mixture was then heated to 85°C (185°F) in a water bath and pasteurized for 5 minutes at 85°C (185°F). The pasteurized mixture was homogenized with a

Silverson apparatus for 2 minutes at medium speed. The homogenized mixture was cooled to 21°C (70°F) in a water bath. The melted orange juice concentrate and vanilla were then added and blended well. The resulting mixture was cooled to 4°C (40°F) and held for 2-3 hours. The mixture was next frozen in a  
5 Taylor Soft Serve Machine and packaged as 10-20 g servings which were hardened in a walk-in freezer at -32°C (-20°F) overnight. Before serving, the frozen product was tempered overnight at -14 to -12°C (6-10°F).

Various No Sugar Added Orange Sherbet compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-  
10 methyl ester were prepared and evaluated to determine the general, preferred, and most preferred ranges. N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten no sugar added orange sherbet generally in an amount between about 5 ppm to about 250 ppm, more preferably from about 20 ppm to about 150 ppm, and most preferably from  
15 about 30 ppm to about 75 ppm.

Examples 2-4: Orange Sherbet (N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with other sweeteners).

Orange Sherbet was prepared in a manner substantially similar to Example 1, with the exception that Examples 2-4 were sweetened with N-[N-(3,3-  
20 dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with another sweetener, i.e., either aspartame (APM), acesulfame-K (Ace-K), or saccharin. In Citrus Sherbet type products, the blend of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and aspartame was the preferred combination of sweeteners. This combination of sweeteners  
25 provides enhanced citrus flavor.

Example 2: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with APM.

Various Orange Sherbet compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and APM were prepared. A low level of one sweetener was combined with a high level of the other sweetener. The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with APM is from about 0.5 ppm to about 60 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 20 ppm to about 1,300 ppm APM. The preferred range is from about 1 ppm to about 50 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 100 ppm to about 650 ppm APM. The more preferred range is from about 7 ppm to about 30 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 100 ppm to about 530 ppm APM. The most preferred blend is about 10 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and about 440 ppm APM.

Example 3: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with Ace-K.

Various Orange Sherbet compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with Ace-K were prepared. A low level of one sweetener was combined with a high level of the other sweetener. The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with Ace-K is from about 1 ppm to about 60 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 20 ppm to about 400 ppm Ace-K. The preferred range is from about 1 ppm to about 50 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 50 ppm to 340 ppm Ace-K. The most preferred range is from about 7 ppm to about 30 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 80 ppm to about 150 ppm Ace-K. The amount of Ace-K is limited by its bitter character and an impression of greasiness or slickness at high concentration levels.

Example 4: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with saccharin.

Various Orange Sherbet compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and saccharin were prepared. A low level of one sweetener was combined with a high level of the other sweetener. The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with saccharin is from about 10 ppm to about 60 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 20 ppm to about 200 ppm saccharin. The preferred range is from about 15 ppm to about 50 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 30 ppm to about 100 ppm saccharin. The more preferred range is from about 20 ppm to about 40 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 40 ppm to about 80 ppm saccharin. The amount of saccharin used is limited by its bitter and metallic character at higher concentrations.

Example 5: No Sugar Added Strawberry Frozen Yogurt (25.1% TS, 1.3% BF, 10.5% NMS).

The constituents used to formulate the No Sugar Added Strawberry Frozen Yogurt of Example 5 are shown in Table 2.

TABLE 2  
Example 5 Formulation  
No Sugar Added Strawberry Frozen Yogurt,  
20 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester

Ingredient	Formula (%w/w)
Part 1	
Skim milk	36.198
Cream, 37% fat	3
SIMPLESSE 500™ (Whey protein conc. available from The NutraSweet Kelco Company, Chicago, IL)	2
M180 MALTRIN™ Maltodextrin	4
LITESSE™ polydextrose	4
NEOSORB P60S™	5
PrimaCel™ (a mixture of microfibrinous cellulose, cellulose gum and sucrose available from The NutraSweet Kelco Company, Chicago, IL)	0.15
DM Freeze 75K™	0.1
N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L- phenylalanine 1-methyl ester	0.002
Part 2	
Strawberry flavor	0.4
Citric acid	0.15
Nonfat yogurt-Dannon (available from Dannon Inc., Minster, OH)	45
Total	100

The No Sugar Added Strawberry Frozen Yogurt of Example 5 was made by first blending the dry ingredients listed in Part 1 of Table 2 to form a dry blend. The dry blend was added to the milk and the cream in a mixer while using



medium shear force. The mixture was then heated to 60-71°C (140-160°F), followed homogenization in a Silverson apparatus at medium speed for 4 minutes. The mixture was then pasteurized at 85°C (185°F) for 4 minutes and cooled to 4°C (40°F). The Part 2 ingredients were next blended in to the cooled mixture. Again the mixture was cooled to 4°C (40°F) and then frozen in a soft serve machine to form the frozen yogurt.

Various Strawberry Frozen Yogurt compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester were prepared and evaluated to determine the general, preferred, and most preferred ranges. N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten strawberry frozen yogurt generally in an amount between about 5 ppm to about 150 ppm, more preferably from about 20 ppm to about 100 ppm, and most preferably from about 30 ppm to about 75 ppm.

Example 6: No Sugar Added Chocolate Milk Drink (12.4% TS, 1.1% fat, 10.3% NMS).

The constituents used to formulate the No Sugar Added Chocolate Milk Drink of Example 6 are shown in Table 3.

TABLE 3  
Example 6 Formulation  
No Sugar Added Chocolate Milk Drink,  
20 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester

Ingredient	Formula (%w/w)
1% fat milk	98.468
DeZaan D-11-S Cocoa (available from ADM, Decatur, Ill)	1.5
VISCARIN G209™ CARRAGEENAN (available from FMC, Philadelphia, PA)	0.02
Kelcogel F™ gellan gum (available from The NutraSweet Kelco Company, Chicago, IL)	0.01
N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L- phenylalanine 1-methyl ester	0.002
Total	100

The No Sugar Added Chocolate Milk Drink of Example 6 was made by first blending the dry ingredients together to form a dry blend. The milk was then added while the mixture was being mixed by a mixer at a high shear force. The mixture was then pasteurized at 88°C (190°F) for 2 minutes, followed by being homogenized in a Silverson apparatus for 4 minutes at low speed. The mixture was next cooled to 21°C (70°F) while stirring and packaged. The packaged Chocolate Milk Drink was refrigerated.

Various No Sugar Added Chocolate Milk Drink compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester were prepared and evaluated to determine the general, preferred, and most preferred ranges. N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten no sugar added chocolate milk drink generally in an amount between about 5 ppm to about 100 ppm, more preferably

from about 20 ppm to about 75 ppm, and most preferably from about 25 ppm to about 40 ppm.

Example 7: No Sugar Added, Low Fat Vanilla Ice Cream (29.56% TS, 2.74% fat, 4.12% protein solids, 10.41% NMS).

- 5 The constituents used to formulate the No Sugar Added, Low Fat Vanilla Ice Cream of Example 7 are shown in Table 4.

TABLE 4  
Example 7 Formulation  
No Sugar Added, Low Fat Vanilla Ice Cream,  
10 20 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester

Ingredient	Formula (%w/w)
Skim milk	70.15
Nonfat dry milk	4
Heavy cream, 37% milk fat	6
15 LITESSE™ polydextrose	7.5
M180 MALTRIN™ Maltodextrin	6.25
NEOSORB P60™ Sorbitol	5
Stabilizer blend, Continental Colloids CC320	1
20 N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L- phenylalanine 1-methyl ester	0.002
Vanilla Flavor 14341, (David Michael, Philadelphia, PA)	0.1
Total	100

- 25 The No Sugar Added, Low Fat Vanilla Ice Cream of Example 7 was made by first adding the skim milk to a mixer and stirring. The stabilizer was gradually adding through a tri-blender. To this mixture, the N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester, malodextrin, nonfat dry milk,

polydextrose, and cream were added. The mixture was heated to 60-71°C (140-160°F), followed by homogenization in a Turrax apparatus at medium speed for 4 minutes. The homogenized mixture was then pasteurized at 85°C (185°F) for 30 minutes and rapidly cooled to 4°C (40°F). The vanilla then was blended in  
5 to the mixture to form the No Sugar Added, Low Fat Vanilla Ice Cream, which was then frozen in a soft serve machine.

Various No Sugar Added, Low Fat Vanilla Ice Cream compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester were prepared and evaluated to determine the  
10 general, preferred, and most preferred ranges. N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten no sugar added, low fat vanilla ice cream generally in an amount between about 5 ppm to about 75 ppm, more preferably from about 10 ppm to about 45 ppm, and most preferably from about 12 ppm to about 30 ppm.

15 Examples 8-11: Low Fat Vanilla Ice Cream (N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with other sweeteners).

Low Fat Vanilla Ice Cream was prepared in a manner substantially similar to Example 7, with the exception that Examples 8-11 were sweetened with N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with  
20 another sweetener, i.e., either aspartame (APM), acesulfame-K (ace-K), saccharin, or sucrose.

Example 8: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with APM.

Various Low Fat Vanilla Ice Cream compositions having different concentrations  
25 of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and APM were prepared. A low level of one sweetener was combined with a high level of the other sweetener. The general range for adding N-[N-(3,3-

dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with APM is from about 1 ppm to about 75 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 100 ppm to about 1,000 ppm APM. The preferred range is from about 1 ppm to about 45 ppm N-[N-(3,3-

5 dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 130 ppm to about 800 ppm APM. The more preferred range is from about 2 ppm to about 30 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 200 ppm to about 600 ppm APM. The most preferred blend is about 3 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-

10 methyl ester and about 500 ppm APM.

Example 9: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with Ace-K.

Various Low Fat Vanilla Ice Cream compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and

15 Acc-K were prepared. A low level of one sweetener was combined with a high level of the other sweetener. The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with Ace-K is from about 1 ppm to about 75 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 100 ppm to about 550 ppm Ace-K.

20 The preferred range is from about 1 ppm to about 45 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 150 ppm to about 500 ppm Ace-K. The more preferred range is from about 2 ppm to about 30 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 200 ppm to about 400 ppm Ace-K. The most

25 preferred blend is about 9 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and about 270 ppm Ace-K.

Example 10: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with saccharin.

Various Vanilla Low Fat Ice Cream compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and saccharin were prepared. A low level of one sweetener was combined with a high level of the other sweetener. The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with saccharin is from about 1 ppm to about 75 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 100 ppm to about 450 ppm saccharin. The preferred range is from about 1 ppm to about 45 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 150 ppm to about 400 ppm. The more preferred range is from about 2 ppm to about 30 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 200 ppm to about 350 ppm saccharin. The most preferred blend is about 3 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and about 300 ppm saccharin.

Example 11: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with sucrose.

Various Vanilla Low Fat Ice Cream compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and sucrose were prepared. A low level of one sweetener was combined with a high level of the other sweetener. The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with sucrose is from about 1 ppm to about 75 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 0.5% (w/w) to about 15% (w/w) sucrose. The preferred range is from about 1 ppm to about 45 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 1.5% (w/w) to about 13% (w/w) sucrose. The more preferred range is from about 2 ppm to about 30 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 3% (w/w) to about 12% (w/w) sucrose. The most preferred blend is about 9 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and about 4.2% (w/w) sucrose.

Example 12: No Sugar Added, Low Fat Chocolate ice cream (31.3% TS, 2.6% fat, 3.9% protein solids, 9.8% NMS).

The constituents used to formulate the No Sugar Added, Low Fat Chocolate Ice Cream of Example 12 are shown in Table 8.

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TABLE 8  
Example 12 Formulation  
No Sugar Added, Low Fat Chocolate Ice Cream,  
20 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester

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20

Ingredient	Formula (%w/w)
Skim milk	68.6684
Nonfat dry milk	3.5
Heavy cream	6.0
DeZaan D-11-S Cocoa Powder	2.0
LITESSE™ polydextrose	7.5
M180 MALTRIN™ maltodextrin	6.25
NEOSORB 60S™ sorbitol	5.0
Stabilizer CC320, Continental Colloids	1.0
N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester	0.0016
Vanilla 14341, David Michael	0.08
Total	100

The No Sugar Added, Low Fat Chocolate Ice Cream of Example 12 was made by adding the skim milk to a jacketed kettle. The sorbitol powder and the stabilizer were dry blended. While rapidly mixing, the dry blend was added to the skim milk. The mixing was slowed and the maltodextrin, nonfat dry milk, polydextrose, cocoa, and cream were added. The mixture was then heated to 60-71°C (140-160°F), followed by being homogenized in a Turrax Apparatus at medium speed for 4 minutes. The homogenized mixture was then pasteurized at 82°C (180°F); the heat was held at 82°C (180°F) for 30 minutes. The mixture was then rapidly cooled to 15°C (60°F). The vanilla and the N-[N-(3,3-

- 22 -

dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester were added to the mixture. The blended mixture was frozen in a soft serve machine. The Chocolate Ice Cream was tempered at -14 to -12°C (6-10°F) before serving.

Various No Sugar Added, Low Fat Chocolate Ice Cream compositions having  
5 different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester were prepared and evaluated to determine the general, preferred, and most preferred ranges. N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten no sugar added,  
10 low fat chocolate ice cream generally in an amount between about 5 ppm to about 75 ppm, more preferably from about 10 ppm to about 45 ppm, and most preferably from about 12 ppm to about 30 ppm.

#### Example 13: Strawberry Yogurt.

The constituents used to formulate the Strawberry Yogurt of Example 13 are shown below in Table 9.

15

TABLE 9  
Example 13 Formulation  
Strawberry Yogurt, 25 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester

20

Ingredient	Formula (%w/w)
Yogurt White Mass	80.0
Strawberry Fruit Prep	20.0
N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester	0.0025
Total	100

25

The Strawberry Yogurt of Example 13 was made by adding the yogurt white mass to a Hobart mixing bowl. The N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-



phenylalanine 1-methyl ester was added to the white mass and mixed with a spatula until it was dispersed throughout the product. The strawberry fruit prep was added to the sweetened white mass and mixed with a paddle for about 10 minutes. The resulting mixture was packaged in plastic deli cups.

- 5 Various Strawberry Yogurt compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester were prepared and evaluated to determine the general, preferred, and most preferred ranges. N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten strawberry yogurt generally in an amount between about  
10 3 ppm to about 70 ppm, more preferably from about 5 ppm to about 60 ppm, and most preferably from about 25 ppm to about 50 ppm.

Examples 14-18: Strawberry Yogurt (N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with other sweeteners).

- Strawberry Yogurt was prepared in a manner substantially similar to Example  
15 13, with the exception that Examples 14-18 were sweetened with N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with another sweetener, i.e., either aspartame (APM), acesulfame-K (ace-K), saccharin, sucralose, or sucrose.

- Example 14: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl  
20 ester blended with APM.

- Various Strawberry Yogurt compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and APM were prepared. A low level of one sweetener was combined with a high level of the other sweetener. The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with APM is from about 3  
25 ppm to about 50 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 100 ppm to about 425 ppm APM. The preferred

range is from about 5 ppm to about 25 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 125 ppm to about 400 ppm APM. The most preferred range is from about 6 ppm to about 15 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from  
5 about 125 ppm to about 375 ppm APM.

Example 15: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with Ace-K.

Various Strawberry Yogurt compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and Ace-K  
10 were prepared. A low level of one sweetener was combined with a high level of the other sweetener. The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with Ace-K is from about 3 ppm to about 50 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 100 ppm to about 500 ppm Ace-K. The preferred  
15 range is from about 5 ppm to about 25 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 100 ppm to about 450 ppm Ace-K. The most preferred range is from about 6 ppm to about 15 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 125 ppm to about 375 ppm Ace-K.

20 Example 16: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with saccharin.

Various Strawberry Yogurt compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and saccharin were prepared. A low level of one sweetener was combined with a  
25 high level of the other sweetener. The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with saccharin is from about 3 ppm to about 50 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 30 ppm to about 300

ppm saccharin. The preferred range is from about 5 ppm to about 45 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 50 ppm to about 250 ppm saccharin. The most preferred range is from about 9 ppm to about 30 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 55 ppm to about 175 ppm saccharin.

Example 17: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with sucralose.

Various Strawberry Yogurt compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and sucralose were prepared. A low level of one sweetener was combined with a high level of the other sweetener. The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with sucralose is from about 3 ppm to about 25 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 40 ppm to about 200 ppm sucralose. The preferred range is from about 5 ppm to about 20 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 45 ppm to about 150 ppm sucralose. The most preferred range is from about 6 ppm to about 15 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from 50 ppm to about 125 ppm sucralose.

Example 18: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with sucrose.

Various Strawberry Yogurt compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and sucrose were prepared. A low level of one sweetener was combined with a high level of the other sweetener. The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with sucrose is from about 3 ppm to about 50 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-

methylester and from about 1.5% (w/w) to about 9% (w/w) sucrose. The preferred range is from about 5 ppm to about 45 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 2% (w/w) to about 7% (w/w) sucrose. The most preferred range is from about 9 ppm to about 30 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 2.25% (w/w) to about 6% (w/w) sucrose.

Example 19: No Sugar Added Chocolate Pie Filling.

The constituents used to formulate the No Sugar Added Chocolate Pie Filling of Example 19 are shown below in Table 10.

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TABLE 10  
Example 19 Formulation  
No Sugar Added Chocolate Pie Filling, 75 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester

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20

Ingredient	Formula (%w/w)
N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester	0.0075
Fresh Milk, Whole or Skim	66.869
Fresh Heavy Cream	16.306
Fresh Whole Eggs	10.277
Corn Starch, Argo	2.398
Unsweetened Chocolate, Baker's	3.639
Table Salt	0.1144
Vanilla Extract	0.3888
Total	100

25

The No Sugar Added Chocolate Pie Filling of Example 19 was made by first whisking together the milk, cream, eggs, starch and salt. The resulting mixture was brought to a boil, whisking almost constantly. The heat was reduced and the mixture was cooked for approximately two minutes. The mixture was

removed from the heat. N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester, chocolate, and vanilla were added and the mixture was whisked until smooth. The resulting mixture was poured into an 8 or 9 inch (20.3 or 22.9 cm) pie shell and refrigerated before serving.

- 5 Various No Sugar Added Chocolate Pie Filling compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester were prepared and evaluated to determine the general, preferred, and most preferred ranges. N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten no sugar added chocolate pie filling
- 10 generally in an amount between about 9 ppm to about 200 ppm, more preferably from about 20 ppm to about 150 ppm, and most preferably from about 40 ppm to about 100 ppm.

Example 20: No Sugar Added Hot Cocoa Mix.

The constituents used to formulate the No Sugar Added Hot Cocoa Mix of

- 15 Example 20 are shown in Table 11.

Table 11  
Example 20 Formulation  
No Sugar Added Hot Cocoa Mix (Reconstituted),  
10 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester

5	Ingredient	Formula % (% w/w)
	N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl	0.0010
	Water, Heated to ~140 F	QS to 100
	Nonfat Dry Milk, Michigan Milk Producers	3.431
10	Sweet Dairy Whey, Michigan Milk Producers	2.304
	Cocoa Powder, DeZaan D-11-S (ADM)	1.229
	Wiptreme 2320, Kerry Ingredients	0.717
	Vanillin, Chart Corp.	0.015
15	CMC9M31 XF, Hercules	0.069
	Flour Salt, Morton	0.061
	Total	100

The No Sugar Added Hot Cocoa Mix of Example 20 was made by adding all ingredients, through a sieve, to a mixing bowl and mixing thoroughly on low for approximately 5 minutes. Hot Cocoa can then be prepared from the mix by adding hot water and stirring vigorously.

Various No Sugar Added Hot Cocoa Mix compositions (reconstituted) having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester were prepared and evaluated to determine the general, preferred, and most preferred. N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten no sugar added hot cocoa mix (reconstituted) generally in an amount between about 7 ppm to about 13 ppm, more preferably from about 8 ppm to about 12 ppm, and most preferably from about 9 ppm to about 11 ppm.

Examples 21-26: Hot Cocoa Mix (N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with other sweeteners).

Hot Cocoa Mix was prepared in a manner substantially similar to Example 20, with the exception that Examples 21-26 were sweetened with N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with  
5 another sweetener, i.e., either sucrose, aspartame (APM), acesulfame K (Ace-K), saccharin, or cyclamate.

Example 21: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with sucrose.

10 Various hot cocoa mix compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and sucrose were prepared. A low level of one sweetener was combined with a high level of the other sweetener. The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with sucrose is from about 1  
15 ppm to about 11 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 1.5% (w/w) to about 10.0% (w/w) sucrose. The preferred range is from about 1 ppm to about 10 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 2.0% (w/w) to about 8.0% (w/w) sucrose. The more preferred range is from about 1 ppm to  
20 about 6.3 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 4% (w/w) to about 7.5% (w/w) sucrose. The most preferred blend is about 5 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and about 4% (w/w) sucrose.

Example 22: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl  
25 ester blended with APM.

Various hot cocoa mix compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with

APM were prepared. A low level of one sweetener was combined with a high level of the other sweetener. The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with APM is from about 0.5 ppm to about 15 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 20 ppm to about 850 ppm APM. The preferred range is from about 1 ppm to about 12 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 30 ppm to about 700 ppm APM. The most preferred range is from about 1 ppm to about 10 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 40 ppm to about 600 ppm APM.

Example 23: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with Ace-K.

Various hot cocoa mix compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with Ace-K were prepared. A low level of one sweetener was combined with a high level of the other sweetener. The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with Ace-K is from about 0.5 ppm to about 12 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 20 ppm to about 360 ppm Ace-K. The preferred range is from about 1 ppm to about 15 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 30 ppm to about 340 ppm Ace-K. The more preferred range is from about 2 ppm to about 10 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 40 ppm to about 300 ppm Ace-K. The most preferred blend is about 5 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and about 200 ppm Ace-K. The amount of Ace-K used is limited by its bitter character at high concentration levels.

Example 24: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with saccharin.



Various hot cocoa mix compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and saccharin were prepared. A low level of one sweetener was combined with a high level of the other sweetener. The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with saccharin is from about 0.5 ppm to about 15 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 10 ppm to about 200 ppm saccharin. The preferred range is from about 1 ppm to about 12 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 15 ppm to about 180 ppm saccharin. The more preferred range is from about 2 ppm to about 10 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 20 ppm to about 150 ppm saccharin. The most preferred blend is about 5 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and about 100 ppm saccharin. The amount of saccharin used is limited by its bitter and metallic character at higher concentrations.

Example 25: N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with cyclamate.

Various hot cocoa mix compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and cyclamate were prepared. A low level of one sweetener was combined with a high level of the other sweetener. The general range for adding N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with cyclamate is from about 0.5 ppm to about 13 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 70 ppm to about 2,400 ppm cyclamate. The preferred range is from about 1 ppm to about 12 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 130 ppm to about 1,300 ppm cyclamate. The more preferred range is from about 1.8 ppm to about 9 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 130 ppm to about 1,000 ppm

cyclamate. The most preferred blends are about 8 ppm to about 9.5 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and from about 130 ppm to about 500 ppm cyclamate. The amount of cyclamate used is limited by its sourness at higher concentrations.

5 Example 26: No Sugar Added Whipped Topping Mix.

The constituents used to formulate the No Sugar Added Whipped Topping Mix of Example 26 are shown in Table 12.

TABLE 12  
Example 26 Formulation  
No Sugar Added Whipped Topping Mix (Reconstituted),  
10 25 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester

Ingredient	Formula (%w/w)
Fresh milk (skim or with fat)	83.66019
15 N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester	0.00251
Wiptreme 2320, Kerry Ingredients	13.65881
Dariloid QH, NutraSweet Kelco	1.36588
Calcium Gluconate, J.T. Baker	1.02441
Tetrasodium Pyrophosphate, Solutia	0.23903
20 Vanillin	0.04917
Total	100

The No Sugar Added Whipped Topping Mix of Example 26 was made by adding all dry ingredients together in a suitable size jar with a screw top. With the lid screwed on tightly, the jar was shaken until the dry mix was well  
25 blended, approximately 5 minutes. Milk was added to a bowl and the dry mix was gradually added to the milk. Using a mechanical mixer, the mixture was blended and then whipped until the topping formed and held peaks. The resulting whipped topping was refrigerated.

Various No Sugar Added Whipped Topping Mix (reconstituted) compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester were prepared and evaluated to determine the general, preferred, and most preferred ranges. N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten no sugar added whipped topping mix (reconstituted) generally in an amount between about 5 ppm to about 75 ppm, more preferably from about 10 ppm to about 50 ppm, and most preferably from about 15 ppm to about 40 ppm.

Example 27: No Sugar Added Vanilla Flavored Instant Pudding Mix.

The constituents used to formulate the No Sugar Added Vanilla Instant Pudding Mix of Example 27 are shown in Table 13.

Table 13  
Example 27 Formulation

No Sugar Added Vanilla Flavored Instant Pudding Mix (Reconstituted),  
45 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester

Ingredient	Formula (%w/w)
Fresh Milk (skim or whole)	94.00651
N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester	0.0045
Redisol Starch 412, Staley	3.0696
Wiptremc 2320, Kerry Ingredients	0.38370
Dariloid QH, NutraSweet Kelco	1.1511
Calcium Gluconate, J.T. Baker	0.7674
Tetrasodium Pyrophosphate, Solutia	0.47963
Salt, Morton	0.05602
Vanilla Powder	0.07674
Yellow #5, Warner Jenkinson	0.00384
Yellow #6, Warner Jenkinson	0.00096

- 34 -

Total	100
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5 The No Sugar Added Vanilla Flavored Instant Pudding Mix of Example 27 was made by adding the Staley starch through a sieve into a suitable size jar with a screw top lid. The rest of the dry ingredients were added. The jar was shaken until the dry mix was well blended, approximately 5 minutes. The milk was added to a bowl and the dry mix was added gradually to the milk. Using a mechanical mixer, the mixture was blended on medium for 30 seconds. The resulting pudding was refrigerated.

10 Various No Sugar Added Vanilla Flavored Instant Pudding Mix (reconstituted) compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester were prepared and evaluated to determine the general, preferred, and most preferred ranges. N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to  
15 sweeten no sugar added vanilla flavored instant pudding mix (reconstituted) generally in an amount between about 10 ppm to about 75 ppm, more preferably from about 15 ppm to about 60 ppm, and most preferably from about 20 ppm to about 50 ppm.

#### DAIRY ANALOGUE PRODUCTS

20 Various dairy analogue product formulations were made with different levels of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester. These levels were selected to establish the levels that would be less sweet than acceptable and sweeter than acceptable.

25 Bench screening was used to evaluate each of the different prototypes for each basic formulation using 100% N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester. The tested examples were frozen dairy analogue

products. The results from this bench screening established 3 ranges, going from a very general to a most preferred range for each application.

Example 28: No Sugar Added Strawberry Sorbet (20.9% TS).

The constituents used in the formulation of the No Sugar Added Strawberry Sorbet of Example 28 are shown in Table 14

TABLE 14  
Example 28 Formulation  
No Sugar Added Strawberry Sorbet,  
35 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester

Ingredient	Formula (%w/w)
Strawberry puree	50
Water	QS to 100
Lemon juice concentrate	0.5
M180 MALTRIN™ maltodextrin	5
LITESSE™ polydextrose	5
NEOSORB P60™ Sorbitol	5
KOB87™ (a guar and xanthan blend, available from The NutraSweet Kelco Company, Chicago, IL)	0.2
N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L- phenylalanine 1-methyl ester	0.0035
Total	100

The No Sugar Added Strawberry Sorbet of Example 28 was made by first blending the dry ingredients together to form a dry blend. The dry blend was added to water in a mixer while using medium shear. Next, the strawberry puree and the lemon juice concentrate were added to the mixture and pasteurized at 85°C (185°F) for 4 minutes. The pasteurized mixture was then homogenized in a Silverson apparatus at low speed for 2 minutes. The mixture was next cooled to 4°C (40°F) and stored in a refrigerator. The cool mixture was frozen

- 36 -

in a soft serve machine and packaged in 10-20 g servings. The individual servings were hardened in a walk-in freezer overnight at  $-7^{\circ}\text{C}$  ( $20^{\circ}\text{F}$ ). The Strawberry Sorbet was tempered at  $-14$  to  $-12^{\circ}\text{C}$  ( $6-10^{\circ}\text{F}$ ) before serving.

5 Various No Sugar Added Strawberry Sorbet compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester were prepared and evaluated to determine the general, preferred, and most preferred ranges. N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten no sugar added strawberry sorbet generally in an amount between about 5 ppm to about 150 ppm, more  
10 preferably from about 20 ppm to about 100 ppm, and most preferably from about 25 ppm to about 50 ppm.

Example 29: No Sugar Added Non-Dairy Vanilla Frozen Dessert based on Soy Milk and Soy Protein (28.32% TS, 2.81% fat, 3.94% protein solids).

The constituents used to formulate the No Sugar Added Non-Dairy Vanilla  
15 Frozen Dessert are shown in Table 15.

TABLE 15  
Example 29 Formulation  
No Sugar Added Non-Dairy Vanilla Frozen Dessert, 16 ppm N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester

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10

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Ingredient	Formula (%w/w)
100% organic, unsweetened Soy beverage, Westbrae Natural Westsoy	73.878
Isolated Soy Protein, ADM Pro Fam 781	1.420
Wiptreme 2320, Kerry Ingredients	2.350
LITESSE™, polydextrose	8.0
M180 MALTRIN™ malodextrin	6.25
NEOSORB 60S™ sorbitol	7.0
Stabilizer CC320, Continental Colloids	1.0
N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester	0.0016
Vanilla Flavor	0.1
Total	100

20 The No Sugar Added Non-Dairy Vanilla Frozen Dessert of Example 29 was made by adding the soy beverage to a jacketed kettle. The sorbitol powder and the stabilizer were dry blended. With rapid agitation, the dry blend was gradually added to the soy beverage. The stirring was slowed and then the maltodextrin, polydextrose, wiptreme, and isolated soy protein were added. The resulting mixture was heated to 65°C (150°F) and mixed in a Turrax high shear

25 mixer for approximately 3 minutes to simulate homogenization. The mixture was then heated to 70°C (160°F) and held at that temperature for 30 minutes. Then the mixture was cooled to 15°C (60°F). The N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester and Vanilla Flavor were added and the resulting mixture was frozen in a soft serve freezer.

30 Various No Sugar Added Non-Dairy Vanilla Frozen Dessert compositions having different concentrations of N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-

- 38 -

phenylalanine 1-methyl ester were prepared and evaluated to determine the general, preferred, and most preferred ranges. N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester can be used to sweeten no sugar added non-dairy vanilla frozen dessert generally in an amount between about 5 ppm to  
5 about 75 ppm, more preferably from about 10 ppm to about 45 ppm, and most preferably from about 12 ppm to about 30 ppm.

The summarized results of the ranges determined for each dairy and dairy analogue products of Examples 1, 5-7, 12, 13, 19, 20, and 26-29 are set forth in Table 16 below.



TABLE 16

	<b>NO SUGAR ADDED PRODUCT</b>	<b>GENERAL RANGE (ppm)</b>	<b>MORE PREFERRED RANGE (ppm)</b>	<b>MOST PREFERRED RANGE (ppm)</b>
5	Orange Sherbet	5-250	20-150	30-75
	Strawberry Frozen Yogurt	5-150	20-100	30-75
	Chocolate Milk Drink	5-100	20-75	25-40
10	Low-fat Vanilla Ice Cream	5-75	10-45	12-30
	Low-fat Chocolate Ice Cream	5-75	10-45	12-30
15	Strawberry Yogurt	3-70	5-60	25-50
	Chocolate Pie Filling	9-200	20-150	40-100
20	Hot Cocoa Mix (reconstituted)	5-30	10-20	10-15
	Whipped Topping Mix (reconstituted)	5-75	10-50	15-40
25	Vanilla Flavored Instant Pudding Mix (reconstituted)	10-75	15-60	20-50
	Strawberry Sorbet	5-150	20-100	25-50
30	Non-Dairy, Vanilla Frozen Dessert	5-75	10-45	12-30

In general, the fruit flavored products tended to have higher most preferred levels than vanilla and chocolate flavored products.

- 40 -

Other variations and modifications of this invention will be obvious to those skilled in this art. This invention is not to be limited except as set forth in the following claims.

## WHAT IS CLAIMED IS:

1. A dairy product comprising N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester in an amount effective to sweeten said dairy product.
2. The dairy product according to claim 1, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 3 ppm to about 250 ppm of said dairy product.
3. The dairy product according to claim 1, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 5 ppm to about 150 ppm.
4. The dairy product according to claim 1, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 10 ppm to about 100 ppm.
5. The dairy product according to claim 1, wherein said dairy product is milk (from various species and of various milkfat content), enzyme treated milk, filled milk, cream, creamers, cultured milk, milk concentrates, dry milk, fluid and dried whey, fluid and dry milk based desserts and beverages, and fluid and dry aerated desserts and topping, frozen fluid dairy products, frozen cultured milk products, or mixtures thereof .
6. The dairy product according to claim 1, further including a gum, stabilizer, or bulking agent.
7. A dairy product comprising N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with a natural or high intensity sweetener in a combined amount effective to sweeten said dairy product.

8. The dairy product according to claim 7, wherein said natural or high intensity sweetener selected from the group consisting of aspartame, acesulfame-salts, sucralose, saccharin, alitame, cyclamates, stevia derivatives, thaumatin, sucrose, high fructose corn syrup, crystalline fructose, high conversion corn syrup, glucose, polyol sugar alcohols, invert sugar and mixtures thereof.
9. The dairy product according to claim 7, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is in an amount of from about 0.1 ppm to about 100 ppm.
10. The dairy product according to claim 5, wherein said dairy product is a fluid dairy product.
11. The dairy product according to claim 10, wherein said fluid dairy product is a liquid, gel, emulsion, or mixture thereof.
12. The dairy product of claim 11, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 5 ppm to about 200 ppm.
13. The dairy product of claim 11, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 20 ppm to about 150 ppm.
14. The dairy product of claim 11, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 25 ppm to about 100 ppm.
15. A fluid dairy product comprising N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with a natural or high intensity sweetener in a combined amount effective to sweeten said fluid dairy product.

16. The dairy product according to claim 15, wherein said natural or high intensity sweetener is selected from the group consisting of aspartame, acesulfame-salts, sucralose, saccharin, alitame, cyclamates, stevia derivatives, thaumatin, sucrose, high fructose corn syrup, crystalline fructose, high conversion corn syrup, glucose, polyol sugar alcohols, invert sugar and mixtures thereof.
17. The dairy product according to claim 15, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is in an amount of from about 0.1 ppm to about 100 ppm.
18. The dairy product according to claim 10, wherein said fluid dairy product is substantially or partially frozen.
19. The dairy product according to claim 18, wherein said dairy product is selected from the group consisting of ice cream, ice milk, sherbet, custards and french ice cream, mellorine, novelties, and the like.
20. The dairy product according to claim 18, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 5 ppm to about 250 ppm.
21. The dairy product according to claim 18, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 10 ppm to about 150 ppm.
22. The dairy product according to claim 18, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 12 ppm to about 75 ppm.
23. A substantially or partially frozen fluid dairy product comprising N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended

with a natural or high intensity sweetener in a combined amount effective to sweeten said substantially or partially frozen fluid dairy product.

24. The dairy product according to claim 23, wherein said natural or high intensity sweetener is selected from the group consisting of aspartame, acesulfame-salts, sucralose, saccharin, alitame, cyclamates, stevia derivatives, thaumatin, sucrose, high fructose corn syrup, crystalline fructose, high conversion corn syrup, glucose, polyol sugar alcohols, invert sugar and mixtures thereof.

25. The dairy product according to claim 23, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is in an amount of from about 0.1 ppm to about 100 ppm.

26. The dairy product according to claim 18, wherein said dairy product is orange sherbet and wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 5 ppm to about 250 ppm.

27. The dairy product according to claim 18, wherein said dairy product is low fat vanilla ice cream and wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 5 ppm to about 75 ppm.

28. The dairy product according to claim 18, wherein said dairy product is low fat chocolate ice cream and wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 5 ppm to about 75 ppm.

29. The dairy product according to claim 5, wherein said fluid milk based dessert is a pie filling and wherein said N-[N-(3,3-dimethylbutyl)-

L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 9 ppm to about 200 ppm.

30. The dairy product according to claim 18, wherein said dairy product is chocolate pie filling.

31. The dairy product according to claim 5, wherein said dairy product is a no sugar added, flavored milk drink and wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 5 ppm to about 100 ppm.

32. The dairy product according to claim 31, wherein said dairy product is a no sugar added chocolate milk drink.

33. The dairy product according to claim 5, wherein said dairy product is a cultured milk product or a frozen cultured milk product.

34. The dairy product according to claim 33, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 3 ppm to about 150 ppm.

35. The dairy product according to claim 33, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 5 ppm to about 100 ppm.

36. The dairy product according to claim 33, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 25 ppm to about 75 ppm.

37. The dairy product according to claim 33, wherein said dairy product is a strawberry yogurt and wherein said N-[N-(3,3-dimethylbutyl)-

L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 3 ppm to about 70 ppm.

38. The dairy product according to claim 33, wherein said dairy product is a strawberry frozen yogurt and wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 5 ppm to about 150 ppm.

39. A cultured milk product or frozen cultured milk product comprising N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with a natural or high intensity sweetener in a combined amount effective to sweeten said cultured milk product or frozen cultured milk product.

40. The cultured milk product or frozen cultured milk product according to claim 39, wherein said natural or high intensity sweetener is selected from the group consisting of aspartame, acesulfame-salts, sucralose, saccharin, alitame, cyclamates, stevia derivatives, thaumatin, sucrose, high fructose corn syrup, crystalline fructose, high conversion corn syrup, glucose, polyol sugar alcohols, invert sugar and mixtures thereof.

41. The cultured milk product or frozen cultured milk product according to claim 39, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is in an amount of from about 0.1 ppm to about 100 ppm.

42. The dairy product according to claim 5, wherein said dairy product is a reconstituted powdered dairy product.

43. The dairy product according to claim 42, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 5 ppm to about 75 ppm.



44. The dairy product according to claim 42, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 8 ppm to about 60 ppm.
45. The dairy product according to claim 42, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 9 ppm to about 50 ppm.
46. The dairy product according to claim 42, wherein said dairy product is reconstituted hot cocoa mix and wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 7 ppm to about 13 ppm.
47. The dairy product according to claim 42, wherein said dairy product is reconstituted whipped topping mix and wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 5 ppm to about 75 ppm.
48. The dairy product according to claim 42, wherein said dairy product is reconstituted vanilla flavored instant pudding mix and wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 10 ppm to about 75 ppm.
49. A reconstituted powdered dairy product comprising N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with a natural or high intensity sweetener in a combined amount effective to sweeten said reconstituted powdered dairy product.
50. The reconstituted powdered dairy product according to claim 49, wherein said natural or high intensity sweetener is selected from the group consisting of aspartame, acesulfame-salts, sucralose, saccharin, alitame, cyclamates, stevia derivatives, thaumatin, sucrose, high fructose corn syrup, crystalline fructose,

high conversion corn syrup, glucose, polyol sugar alcohols, invert sugar and mixtures thereof.

51. The reconstituted powdered dairy product according to claim 49, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is in an amount of from about 0.1 ppm to about 100 ppm.

52. The dairy product according to claim 5, wherein said dairy product is a non-reconstituted powdered dairy products and said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 30 ppm to about 1,250 ppm.

53. The dairy product according to claim 52, wherein said dairy product is a non-reconstituted powdered dairy products and said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 60 ppm to about 1,000 ppm.

54. The dairy product according to claim 52, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 90 ppm to about 835 ppm.

55. The dairy product according to claim 52, wherein said dairy product is non-reconstituted hot cocoa mix and wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 90 ppm to about 170 ppm.

56. The dairy product according to claim 52, wherein said dairy product is non-reconstituted whipped topping mix and wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 30 ppm to about 460 ppm.

57. The dairy product according to claim 52, wherein said dairy product is non-reconstituted vanilla flavored instant pudding mix and wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is present in an amount of from about 170 ppm to about 1,250 ppm.
58. A non-reconstituted powdered dairy product comprising N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with a natural or high intensity sweetener in a combined amount effective to sweeten said non-reconstituted powdered dairy product.
59. The non-reconstituted powdered dairy product according to claim 58, wherein said natural or high intensity sweetener is selected from the group consisting of aspartame, acesulfame-salts, sucralose, saccharin, alitame, cyclamates, stevia derivatives, thaumatin, sucrose, high fructose corn syrup, crystalline fructose, high conversion corn syrup, glucose, polyol sugar alcohols, invert sugar and mixtures thereof.
60. The non-reconstituted powdered dairy product according to claim 58, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is in an amount of from about 0.6 ppm to about 1,700 ppm.
61. A dairy analogue product comprising N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester in an amount effective to sweeten said dairy analogue product.
62. The dairy analogue product according to claim 61, wherein said dairy analogue product is selected from the group consisting of soy milk, soy powder, caseinates, non-dairy coffee whiteners, sorbet and non-dairy novelties.
63. The dairy analogue product based product according to claim 61, further comprising a gum, stabilizer, or bulking agent.

64. A dairy analogue product comprising N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester blended with a natural or high intensity sweetener in a combined amount effective to sweeten said dairy analogue product.

65. The dairy analogue product according to claim 64, wherein said natural or high intensity sweetener is selected from the group consisting of aspartame, acesulfame-K, sucralose, saccharin, alitame, cyclamates, stevia derivatives, thaumatin, sucrose, high fructose corn syrup, crystalline fructose, high conversion corn syrup, glucose, polyol sugar alcohols, invert sugar and mixtures thereof.

66. The dairy analogue product according to claim 64, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is in an amount of from about 0.1 ppm to about 100 ppm.

67. The dairy analogue product according to claim 61, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is in an amount of from about 5 ppm to about 150 ppm.

68. The dairy analogue product according to claim 61, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is in an amount of from about 10 ppm to about 100 ppm.

69. The dairy analogue product according to claim 61, wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is in an amount of from about 12 ppm to about 50 ppm.

70. The dairy analogue product according to claim 61, wherein said dairy analogue product is strawberry sorbet and wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is in an amount of from about 5 ppm to about 150 ppm.

71. The dairy analogue product according to claim 61, wherein said dairy analogue product is a no sugar added vanilla frozen dessert based on soy milk and soy protein and wherein said N-[N-(3,3-dimethylbutyl)-L- $\alpha$ -aspartyl]-L-phenylalanine 1-methyl ester is in an amount of from about 5 ppm to about 75 ppm.

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 98/27176

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 6 A23L1/236

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 A23L A23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 95 30689 A (C.NOFRE ET AL.) 16 November 1995 see page 1, line 14-19 see page 2, line 15-17 see page 10, line 30-37 ---	1-71
A	US 5 480 668 A (C.NOFRE ET AL.) 2 January 1996 cited in the application see column 1, line 1-60 see column 3, line 62 - column 4, line 37 see column 5, line 63 - column 6, line 26 see claims 1,3,6,7; table I ---	1-71
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents :

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Date of the actual completion of the international search

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# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 98/27176

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P, X	<p>WO 98 39979 A (AJINOMOTO)  17 September 1998  see the whole document  &amp; DATABASE WPI  Section Ch, Week 9843  Derwent Publications Ltd., London, GB;  Class B05, AN 98-506404  &amp; WO 98 39979 A (AJINOMOTO)  , 17 September 1998  see abstract</p>	1-71
A	<p style="text-align: center;">---</p> <p>CA 1 267 030 A (OSHAWA GROUP)  27 March 1990  see claims 1,5,7,8,11; example 2</p>	1-71
A	<p style="text-align: center;">---</p> <p>US 5 093 137 A (W.H.SHAZER ET AL.)  3 March 1992  see claims</p> <p style="text-align: center;">-----</p>	1-71

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International Application No

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Form PCT/ISA/210 (patent family annex) (July 1992)

